Claims

1. A differential diameter hole drilling method by which a through-hole having improved wall surface uniformity and a predetermined diameter is formed in a target material having a thickness, comprising:

generating a first laser output having sufficient energy density over a first spatial spot size to remove target material within a first spot area defined by the first spatial spot size;

directing the first laser output to impinge the target material and thereby form a pilot hole having a first diameter that corresponds to the diameter of the first spot area and that is less than the predetermined diameter of the through-hole;

generating a second laser output having sufficient energy density over a second spatial spot size to remove target material within a second spot area defined by the second spatial spot size; and

directing the second laser output to impinge the target material such that the resulting second spot area is greater than the first spot area of the pilot hole to form a through-hole having the predetermined diameter and that extends through the thickness of the target material, the formation of the through-hole involving the addition of thermal energy that escapes through the pilot hole and thereby limits thermal distortion of the through-hole wall and enhances its surface uniformity.

2. The differential diameter hole drilling method of claim 1, in which the target material includes opposed first and second major surfaces and in which the first laser output impinges the first major surface of the target material to form the pilot hole and thereafter the second laser output impinges the first major surface of the target material to form the through-hole.

3. The differential diameter hole drilling method of claim 1, in which the generating and directing the second laser output to impinge the target material includes forming a portion of the through-hole before forming the pilot hole, the portion of the through-hole having the predetermined diameter and extending only partly through the thickness of the target material.

4. The differential diameter hole drilling method of claim 1, in which the pilot hole and the through-hole have, respectively, a pilot hole axis and a through-hole axis, and in which the directing the second laser output to impinge the target material includes spatially aligning the through-hole and pilot hole axes.

5. The differential diameter hole drilling method of claim 1, in which the pilot hole extends only partly through the thickness of the target material.

6. The differential diameter hole drilling method of claim 1, in which the pilot hole extends through the thickness of the target material.

7. The differential diameter hole drilling method of claim 1, in which the through-hole has a diameter of less than 150 microns.

8. The differential diameter hole drilling method of claim 1, in which the target material comprises a non-homogeneous material.

9. The differential diameter hole drilling method of claim 8, in which the target material comprises a multi-layered electronic circuit board.

10. The differential diameter hole drilling method of claim 9, in which the multi-layered electronic circuit board comprises a multi-layered fiberglass reinforced printed circuit board.

11. The differential diameter hole drilling method of claim 1, in which the first and second laser outputs are generated by a laser selected from the group consisting essentially of UV lasers, CO_2 lasers, and non-excimer lasers.

12. The differential diameter hole drilling method of claim 1, in which the UV laser is a UV:YAG emitting a laser beam having a wavelength of 355 mm.

13. The differential diameter hole drilling method of claim 1, in which the first and second laser outputs are generated by the same laser.

14. The differential diameter hole drilling method of claim 1, in which the first and second laser outputs are generated by respective first and second lasers.